# Magnetic Field Parameters Determination for the Magneto-mechanical Activation of Ehrlich Ascites Carcinoma Cells Using Aptamers with Magnetic Nanoparticles

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Magneto-mechanical activation in nonheating low-frequency magnetic field is a promising method for cancer therapy. It is contactless with very high penetration depth (>1 m) and a minimum of side effects and risks. Nevertheless, there is still no developed theory and a sufficient amount of experimental data [1]. The aim of this study was to determine the parameters of magnetic field oscillation frequency and signal waveform to perform the magneto-mechanical activation of Ehrlich ascites carcinoma cells using aptamers with magnetic nanoparticles.

The following materials and reagents were used: aptamers As-42 and As-14 (IDT, USA), gold coated magnetic nanoparticles with a diameter of 50 nm (NITmagold Cit 50nm, Spain) and silicon dioxide coated magnetic nanoparticles with a diameter of 40 and 80 nm (Boreskov Institute of Catalysis, Russia), Erlich ascites carcinoma cells, DPBS, TCEP, PBS buffer. The coil was 25 mm in diameter and generated magnetic inductance of 10 mT. The frequency was set using SweepGen (David Taylor). Dead cells were stained with trypan blue dye.

Sinusoidal and meander waveforms were studied. Frequency varied from 4 to 180 Hz. The results indicate that the maximum effect of magneto-mechanical activation was observed when using the meander waveform with the 50-60 Hz oscillation frequency of the magnetic field. Nanoparticles coated with silicon dioxide with a diameter of 80 nm showed comparable results with gold coated nanoparticles with a diameter of 50 nm. The mortality rate of cancer cells reached 35% after 20 minutes of exposure to an alternating magnetic field.

With such parameters of nanoparticle size and the magnetic field oscillation frequency, the most likely mechanism of activation of biochemical pathways leading to the death of cancer cells is the activation of various ion channels [1].

Thus, nanoparticles with a diameter of 80 nm, coated with silicon dioxide, and nanoparticles, coated with gold, with a diameter of 50 nm are suitable for developing the means of magnetomechanical therapy. Further studies will focus on finding the optimal time of exposure to a magnetic field and the selection of the optimal frequency of field oscillations.

[1] Yu. I. Golovin, Nanotechnol Russia 13, 215 (2018)